Electronic Medical Record Integration for Streamlined DEXA Reporting

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Introduction

Dual-energy X-ray absorptiometry is the most frequently performed examination to assess bone mineral density (BMD) in clinical practice. The primary output of DEXA exams is a group of numbers comprised of multiple BMD values that are displayed on a screen capture within the PACS workstation. These values are typically manually dictated into the diagnostic report, which takes time and is prone to transcription errors. Exporting the DEXA numerical data via HL7 engine to the electronic medical record (EMR) was proposed to improve reporting efficiency and accuracy.

Materials and Methods

The DEXA modality devices and EMR interfaces were modified to support sending discrete measurement data details directly from the modality through an HL7 interface into the reporting application function within the EMR. The data was formatted in such a way as to allow posting in the EMR as a preliminary report with a header highlighting the fact it was machine generated. At that point, standard EMR report functionality was used by the reporting radiologist to modify this machine generated report to include the interpretive details. EMR smart feature elements were created to streamline and standardize the interpretive reporting elements (Image 1). The workflow

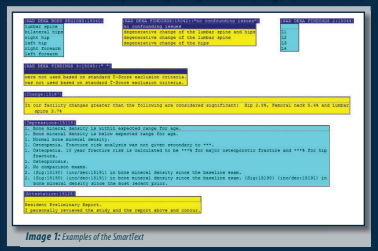

Image 1: Examples of the SmartText

was initially developed as EMR driven, but was later integrated into a PACS driven workflow."In order to evaluate whether this quality improvement initiative led to decreased errors, 100 preliminary DEXA radiology reports before the change and 100 after the change were examined. All reports went through a resident preliminary reporting process. These reports were analyzed for errors that included decimal change, number transposition, negative number issue, other incorrect number error, and failure to include prior exam for comparison. Errors by residents and errors by attending physicians for each report in each category were then tabulated and pre- and post-change scores were compared. In addition, report turnaround times were evaluated before and after the changes were made based on EMR timestamps for the different exam statuses (exam begin, exam end, preliminary report, and final report). Time evaluations included one year volume prior to change (3915 reports) and 1 month post change (206 reports).

Results

Out of 100 DEXA exams before the change, 20 preliminary reports contained 44 errors and 15 final reports contained 25 errors. The errors were comprised of incorrect numerical values and missing comparison references. The incorrect numbers were seen in both the manually entered T and Z score fields. 7 errors in both the preliminary and final reports were found related to negative number issues. Zero errors were identified for decimal placement or simple number transposition. 35 otherwise incorrectly transcribed numbers were found in the preliminary report, while only 18 made it to the final report. 2 preliminary reports were identified without the prior listed for comparison, but none were found in the final report (Table 1). Out of 100 DEXA exams after the change, only 1 preliminary report and 1 final report contained errors, and in both cases this included the prior not being listed for comparison.

	Pre Change Prelim	Pre Change Final	Post Change Prelim	Post Change Final
Number of Reports	100	100	100	100
Number of Reports with Errors	20	15	1	1
Range of Errors per report	1-9	1-8	1	1
Number of Errors	44	25	1	1
Decimal issue	0	0	0	0
Number transposition	0	0	0	0
Negative number issue	7	7	0	0
Other incorrect number	35	18	0	0
Prior not listed for comparison	2	0	1	1

Table 1: Change in error between pre- and post-change of DEXA reporting

Exam end to preliminary report time decreased from 1235 minutes to 0 minutes average (153 minutes to 4 minutes median). Exam end to final report time decreased from 2159 minutes to 625 minutes average (1252 minutes to 225 minutes median). Exam begin to final report time decreased from 2197 minutes to 670 minutes average (1278 minutes to 260 minutes median) (Tables 2 and 3).

Compared to other available solutions, the relative cost of build and installation of our automation solution is relatively more affordable. One of the commercially available options explored for automation included a 3rd party application that costs about $160,000 including install and a 5 year maintenance contract. This is opposed to the estimated $6,175 install for our solution that requires no maintenance cost.

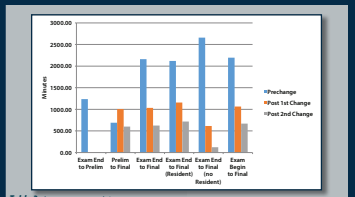

Table 2: Average turnaround times

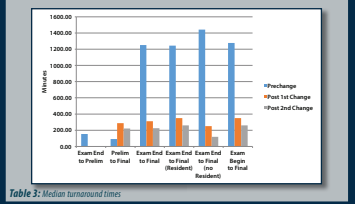

Table 3: Median turnaround times

Results

Typical reports include the patient history, technique, comparison, findings, and clinical impression. Within the findings portion of the pre-change manually created reports were 15-20 manually dictated numerical fields (Image 2). Secondary to the time consuming and likely error prone process of manually dictating the 15-20 numerical values in the report, an alternate solution was sought.

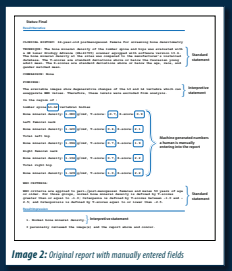

Image 2: Original report with manually entered fields

The initial solution that was attempted was a brief report that listed the patient's diagnosis category and other impressionable information, such as fracture risk analysis and confounders, but excluding all of the manually entered values in the findings section of the report (Image 3). The brief report however, was not well received by many of the referring clinicians who desired the extra information in the original reporting format. Therefore other solutions were again needed.

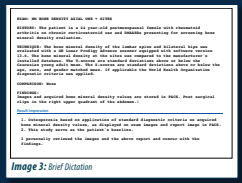

Image 3: Brief Dictation

The process of an automated data entry based upon the current imaging and EMR systems was then evaluated. The new process was able to directly push the pertinent information from the DEXA scanner, which was originally dictated into the findings section, directly into the EMR. With the leveraging of smart features in the EPIC/EMR environment, a customized report with the look and information of the original report was able to be obtained, without the need for manual data entry (Image 4).

This change did cause a change in the standard PACS driven workflow that had been normally used in the radiology department. Rather than launching the exam from PACS to dictation software and completing a report, the exam was viewed in PACS but then interpreted and reported directly in EPIC/EMR. New EPIC standard tools were incorporated in the workflow to give the customized feel that the referents desired, while allowing the T and Z scores to be automated.

At the time of the new reporting workflow that directly pushed DEXA information to the EMR, our PACS and EMR were not integrated. However, about 1 month later with the support of our institutional leadership a full PACS and EMR integration was achieved. This allowed for the radiologist to simply open the case from either the EMR or the PACS and has the other system also linked to open the correlative information. This allowed for simultaneous viewing of images and reporting without having to open the patient in each separate system. This integration was done with the hope of further improving efficiency.

An evaluation of the efficiency or report turnaround times was performed comparing the initial pre-change, 1st post change and 2nd post change times. We found a shorter turnaround time in nearly all measureable data comparing the 3 categories (Tables 2 and 3). The exam end time to prelim was cut to zero in both of the post changes as the DEXA modality was automatically sending the raw data to the EMR in a preliminary report. It appeared that the preliminary report to final report turnaround time was longer, but this was an artifact of the modality sending a preliminary report directly to the EMR rather than being created by an interpreting radiology resident. The most significant measure of improved efficiency was the category of exam end to final, which showed an incremental improvement independent of whether a resident was assisting in report creation or staff was doing the full process.

An additional change that was seen between the pre-change and both post-changes was an increase in staff physicians interpreting exams without the help of residents. This was felt to be due to the improved efficiency of the new system, less burden of reporting and greater acceptance by the faculty (Table 4).

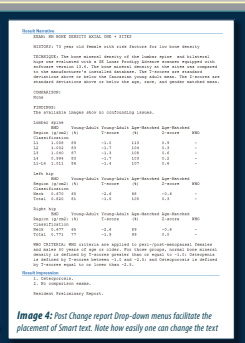

Image 4: Post Change report Drop-down menus facilitate the placement of Smart text. Note how easily one can change the text

	Total Exams	Read with Resident	Percent with Resident
Pre Change (~1 year)	3915	3622	92.52%
Post 1st Change Modality Integration (~1 month)	192	147	76.56%
Post 2nd Change PACS Integration (~1 month)	206	173	83.98%

Table 4: Improvements and Efficiency gains

Discussion

Many health information technology tools are available to aid in report generation, including speech recognition software and structured reporting (2). Tools such as voice recognition software have even shown improved report turnaround times (3). However the available tools that were being used to create DEXA reports at our institution, essentially templates with blank fields for DEXA report entries, were tedious and error prone. Commercial solutions were available but without an available budget to purchase and install.

The reporting for DEXA examinations was historically managed by having the resident and staff physicians use a PACS driven workflow that was linked to voice recognition dictation software at our institution and elsewhere at most radiology practices (4). This was done in a standardized format, as recommended by the 2007 intersociety conference, to demonstrate both the study findings and procedure being performed (5).

Other in house solutions have been reported, including methods using Microsoft Windows based macro script editing and reported to be "inexpensive" (6). However, the availability, applicability and ease of use across multiple health system platforms were not discussed. Another benefit of our solution compared to Iv et al's macro script driven solution is that no DEXA specific workstation must be used to report, nor are there healthcare information security issues since we are using our standard workstations. Our solution also has the advantage of not being linked to the voice recognition software that was a problem which Iv et al were unable to overcome.

One problem that was encountered when changing the reporting of DEXA examinations was the adjustment from a PACS driven workflow to a Radiology Information System driven workflow. Radiologists at our institution generally open studies in PACs, and then are able to dictate into voice recognition software. The initial change that was make of sending data to EPIC allowed one to look at the images in PACS, but reporting was then done in EPIC. Initially our PACS and EMR were not integrated, which made the workflow cumbersome. Subsequently, we were able to integrate our PACS and EMR with launch in context, so that when a study was opened in the EMR or PACS, the other system would be showing the same patient's information. This helped to reduce the number of clicks that a physician needed to perform to view, interpret and complete a report.

Abujudeh, et al has previously shown that the automated insertion of technical details have improved report and billed examinations (7). We hypothesized that a similar method of automation would allow for improvement in the number of errors for similar technical details.

The rate of error was improved after the change, as no numerical errors were found in preliminary or final reports. Only one error in the post change group was found, in which a comparison report was not included. This was caused by a naming convention change that occurred after that report comparison which had not been accounted for in the EMR template build, but which was subsequently corrected after identification.

The growing use of electronic medical records for the use of health information is growing (8). Epic is a leading vendor of EMR systems, which makes this solution applicable to a broad population. The HL7 format of the information is an ANSI-accredited standard for network and application integration, available with most healthcare products. Given the broad use of Epic and standardized HL7 data, our method of automated report generation should be applicable to a large number of physicians and medical facilities who perform DEXA reporting and interpretation. Our solution also has the advantage of being more affordable than the currently available commercial solutions mentioned previously.

Conclusion

We present a cost effective solution that improves report turnaround time and accuracy. Before implementation of the change, 15% (15/100) of final reports contained errors, while only 1% (1/100) of final reports had errors after the change. Moreover, turnaround time report generation was improved in a variety of measures. Secondary to the affordability and applicability to the large percentage of the population using electronic medical record systems, this type of automated workflow is recommended.

References

1. Health Level 7. http://www.hl7.org
2. Khorasani R. Can health IT tools enable improved documentation of quality, safety measures, and regulatory requirements in radiology reports? *J Am Coll Radiol. 2013 May;10(5):381-2.* doi: 10.1016/j.jacr.2013.02.003. PubMed PMID: 23642880.
3. Andriole K.P., Prevedello L.M., Dufault A., et al: Augmenting the impact of technology adoption with financial incentive to improve radiology report signature times. J Am Coll Radiol 2010; 7: pp. 198-204
4. Zimmerman SL, Kim W, Boonn WW. Informatics in radiology: automated structured reporting of imaging findings using the AIM standard and XML. Radiographics. 2011 May-Jun;31(3):881-7. doi: 10.1148/rg.313105195. Epub 2011 Feb 25. PubMed PMID: 21357413.
5. Dunnick NR, Langlotz CP. The radiology report of the future: a summary of the 2007 Intersociety Conference. J Am Coll Radiol. 2008 May;5(5):626-9. doi: 10.1016/j.jacr.2007.12.015. PubMed PMID: 18442766.
6. Iv M, Patel MR, Santos A, Kang YS. Informatics in radiology: use of a macro scripting editor to facilitate transfer of dual-energy X-ray absorptiometry reports into an existing departmental voice recognition dictation system. Radiographics. 2011 Jul-Aug;31(4):1181-9. doi: 10.1148/rg.314105741. Epub 2011 May 5. PubMed PMID: 21546554.
7. Abujudeh HH, Govindan S, Narin O, Johnson JO, Thrall JH, Rosenthal DI. Automatically inserted technical details improve radiology report accuracy. J Am Coll Radiol. 2011 Sep;8(9):635-7. doi: 10.1016/j.jacr.2011.02.009. PubMed PMID: 21889750.
8. http://www.healthit.gov/sites/default/files/rtc_adoption_and_exchange9302014.pdf